Salt Marsh Elevation

Using surface elevation tables to monitor long-term change

Background

Salt marshes are critical coastal resources of the intertidal zone at Cape Cod National Seashore (CACO) and throughout coastal parks. CACO is currently implementing several long-term monitoring programs within these ecosystems, including one focused on sediment elevation.

Predicted acceleration in the rate of sea-level rise threatens the long-term sustainability of these ecosystems. If salt marshes do not accrete sediment at a rate similar to sea level rise, changes in vegetation composition will arise, and plants will gradually drown and die. Eventually the marsh will convert to subtidal, shallow open water habitat through soil subsidence and erosion.

It is critical to obtain high-resolution measures of soil elevation change relative to sea level rise to determine marsh vulnerability to submergence. Understanding relationships between salt marsh accretion, elevation change, accelerated sea level rise, and anthropogenic alterations of the estuarine system and watershed is critical to determining long-term sustainability of salt marshes at CACO and other coastal parks.

Status & Trends

CACO is currently monitoring sediment elevation changes at twenty-eight sites in three different marsh systems:

1. Hatches Harbor, Provincetown
2. Herring River, Wellfleet
3. Nauset Marsh, Orleans

The salt marsh systems at Hatches Harbor and the Herring River have both restricted (tidal flow is altered) and unrestricted (tidal flow is not altered) areas. CACO scientists monitor both restricted and unrestricted areas in both of these systems for salt marsh elevation. Nauset Marsh has always been entirely unrestricted and is the reference system for salt marsh elevation studies.

CACO scientists employ Surface Elevation Tables (SET) to monitor changes in marsh elevation and artificial soil marker horizons (Marker Horizon) to measure vertical accretion of the salt marsh (Figure 1).

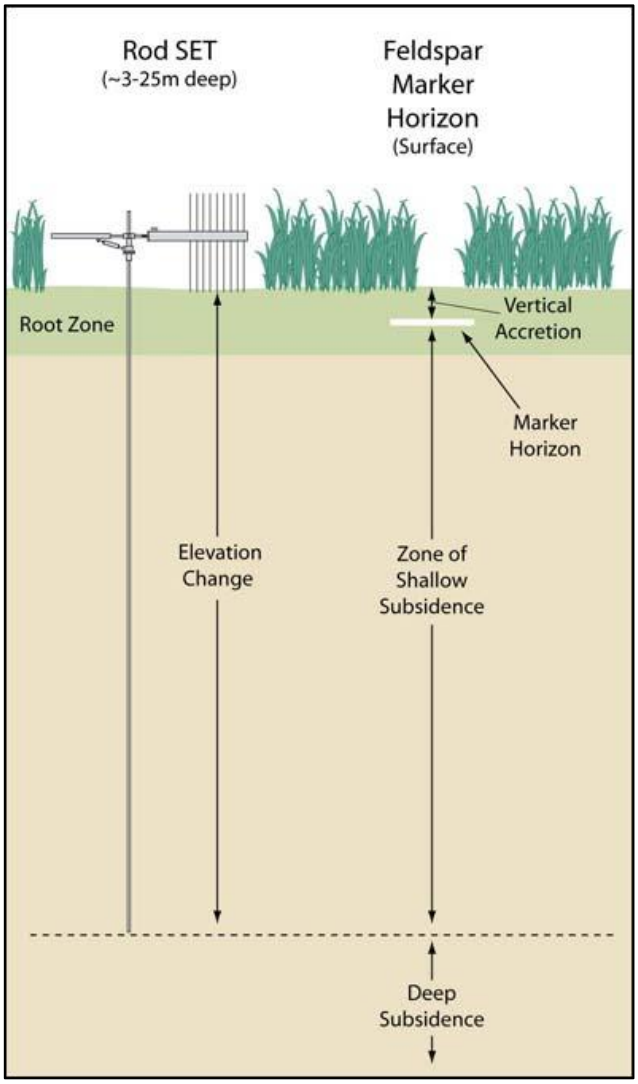

Figure 1. A diagram illustrating a typical SET and feldspar marker horizon at a permanent station. Used simultaneously, the SET and Marker Horizon techniques can provide information on below ground processes that influence elevation change.

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More Information

Kelly C Medeiros, CACO Hydrologic Technician
Email: kelly_medeiros@nps.gov
Phone: 508-487-3262 x0506
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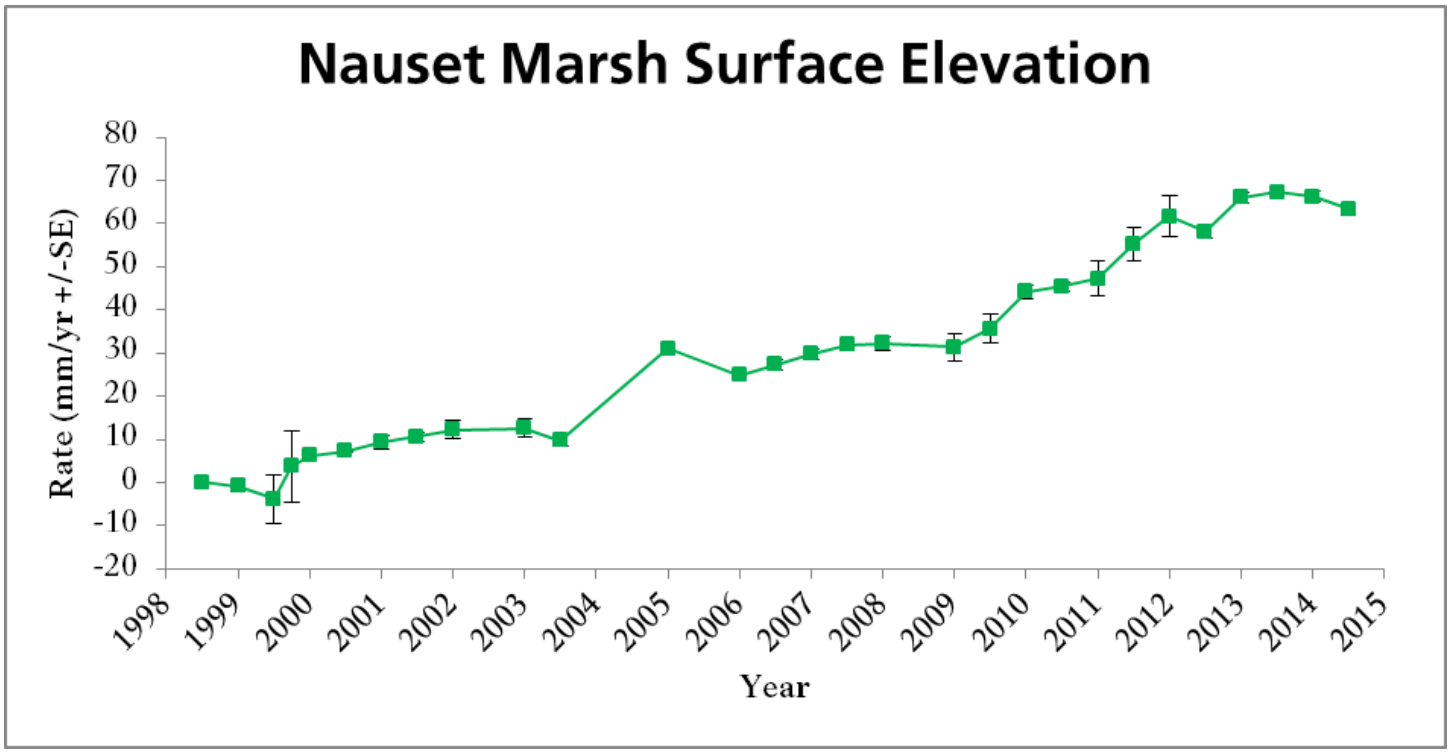

Figure 2. Surface elevation change at Nauset Marsh from 1998 through 2014. The rate of elevation change is above 4 mm/year, indicating that this site has been able to keep pace with the regional rate of sea level rise (~2.8 mm/year).

Data obtained using the SET/Marker Horizon method show highly variable elevation change in all unrestricted salt marsh areas. Only Nauset Marsh, the only entirely unrestricted salt marsh system, is producing a rate of elevation change (4.32 mm/year) that exceeds the regional rate of sea level rise (2.8 mm/year).

Management Applications

Determining rates of elevation change, and gaining understanding of the processes causing elevation change, requires precise measures of marsh elevation.

As sea level rise and other anthropogenic stresses accelerate, the trajectory of salt marsh surface elevation change is a critical component for the understanding of salt marsh stability in both the short and long-term.

Data collected with the SET/Feldspar Horizon Marker method enables CACO park managers to determine if surface elevation is keeping pace with sea level rise and can help in deciding whether to manage surface or subsurface processes of sediment and organic matter accumulation to maintain surface elevation in both natural and restored marshes.

At Gateway National Recreation Area, the Jamaica Bay salt marsh is disappearing rapidly. Efforts to halt the marsh decline to date have included spraying thin layers of sediment onto the marsh surface as well as adding sediment backfill to halt further erosion. Though CACO has not experienced drastic surface loss, our long-term monitoring program will enable park scientists to provide timely reports of changes in marsh elevation and accretion rates, and empower management to react quickly with similar methods if advisable.

Salt marsh elevation trajectories are also useful for interpreting any observed long-term changes in salt marsh vegetation and associated fauna. Many salt marsh plants are sensitive to the duration of salt water inundation, which is directly related to elevation. Changes in elevation and sediment accumulation observed within CACO's three monitoring sites will help park scientists understand, and possibly predict, changes in the distribution of key salt marsh plant species.